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# **Why do good?**

## **Understanding the role of farmers' norms and beliefs as predictors of adoption of good management practice in Southland**

A thesis

submitted in partial fulfilment

of the requirements for the Degree of

Master of Natural Resource Management and Ecological Engineering

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Sarah-Jane Luoni

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## Abstract

This research investigates how farmers' norms and beliefs predict adoption of 10 farm specific good management practices (GMPs) for improved water quality in Southland. These GMPs are components of Environment Southland's Water and Land 2020 & Beyond Project.

Based on these GMPs, a survey was conducted which was informed by a modified version of Stern's Values-Beliefs-Norms model (mBN). The modification excluded Stern's values and new ecological paradigm components, in order to focus on beliefs and norms as the most proximal determinants of GMP adoption. The mBN assumes a causal linear chain whereas the results suggest that beliefs and norms can independently effect adoption of GMPs. Parts of the model display significance for predicting GMP adoption but overall the results show the hypothesised mBN model was a poor fit to the observed data.

The discussion identifies the potential role of the individual beliefs and norm components as targeted intervention points for desired behaviour change and considers alternative models and their merits for future research.

**Keywords:** Good Management Practice, Farming, Agriculture, Water Quality, Behavioural Theory, Stern, VBN, Values, Norms, Beliefs, Southland, Pro-Environmental Behaviour, Freshwater, Water Quality, Social Licence.

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# Chapter 1

## Introduction

### 1.1 National Water Quality Challenges

Nutrient loss from agricultural activities has been identified as a contributor to declining water quality in New Zealand (Wright, 2012). This nutrient loss occurs when rain washes nutrients and sediment from silt, fertiliser, urine and manure, off farmland and into connecting waterways. This loss from the land is not a gain for the water; nutrification and sedimentation, with associated bacteria, have the ability to severely degrade aquatic ecosystems. There are three main pollutants of fresh water in New Zealand – pathogens, sediment, and nutrients. As Wright (2012, p. 9) has noted, "Pathogens make people and animals sick. Sediment makes clear water murky and blankets stony riverbeds with mud and silt. Excess nutrients (nitrogen and phosphorus) can lead to rampant weed growth, algal blooms, and oxygen depletion".

It is important to note that farming is not the only contributor to water quality issues in New Zealand. However, as this research is focused on farmers' decision-making processes, the issues beyond farming will be largely excluded from this discussion.

The diffuse nature of nutrient loss means that it is difficult to pinpoint individual farm contributions and measure exact losses. However, land use and water quality are measurable. Approximately 40% of New Zealand's land area is utilised for agriculture of some kind (Wilcock, 2013) and about 97% of nutrient loads entering waterways are from diffuse sources, such as agricultural runoff, where effects are cumulative across a catchment (Wilcock, 2013).

For the last 25 years, NIWA has been monitoring waterways nationwide. In this time, it has observed

a general decline in river water quality when using nitrogen levels as a key indicator (Statistics New Zealand, 2017). However, there have been measured improvements in areas where work has gone into improving land management practice, soil conservation and nutrient controls, and there are signs that "river water quality declines can be arrested or even reversed" (Davies-Colley, 2013, para. 10).

## **1.2 Freshwater Management in New Zealand**

In New Zealand, fresh water and the activities that affect it are governed by the Resource Management Act 1991. Central government sets management directives, and responsibility for implementing these directives rests with regional councils. In 2003, a national Water Programme of Action assessed the pressures freshwater was facing in New Zealand and it found that:

1. Not all expectations and needs for freshwater were being met and demands were growing;
2. Water quality was declining in many areas and was unacceptable in some;
3. Given the range of people's interests in water (social, economic, environmental and cultural) it is difficult under the present system to establish priorities for action.

(Ministry for the Environment & Ministry of Agriculture and Forestry, 2004, p. 14).

These results led to recommendations for central government to have a more hands-on role in directing local management (Ministry for the Environment & Ministry of Agriculture and Forestry, 2004) and in 2008 the Minister for the Environment established the Land and Water Forum with iwi, agricultural, industrial, urban and environmental organisation representatives. This forum contributed to the 2011 National Policy Statement for Freshwater Management (NPS-FM) which was updated and became effective in 2014 (Feltham, 2015, para. 11).



The NPS-FM introduced a 4-step rating system where waterways are classified as either; suitable for drinking, suitable for swimming, suitable for boating, or unsafe for human use. The government drew the bottom line at a measure where waterways are deemed 'suitable for boating'; which means that theoretically all waterways in New Zealand should be safe for some form of human use. The NPS-FM includes the National Objectives Framework to help councils set freshwater objectives in their regional plans which meet community and tāngata whenua values for local water bodies. Along with this rating system the NPS-FM also requires councils to account for how much water is taken from a water body and any contaminants that are discharged into it (Ministry for the Environment, 2013).

Throughout the past year New Zealand's freshwater resources have been at the forefront of media coverage and political campaigning. Before the 2017 general election, the National led Government proposed and consulted on amendments to the NPS-FM with the Clean Water Package 2017, this re-defined the criteria for swimmable waterways and proposed:

- A new target that 90% of rivers and lakes are swimmable by 2040;
- Changes to the NPS-FM including water quality requirements for recreation, limiting nutrients and for ecological health;
- New national stock exclusion regulations.

(Ministry for the Environment, 2017)

As these changes were being implemented, the 2017 election campaign was underway and freshwater reform was a significant issue on the political agenda.

The election resulted in a change of government and the formation of a Labour-New Zealand First coalition with support from the Green Party. The Labour Party Water Policy document (New Zealand Labour Party, 2017) outlines their intention for future change with a twelve point plan and strong support for improved water quality. The 2017 change of government is likely to mean more adjustments to how freshwater is managed, measured and monitored in New Zealand.

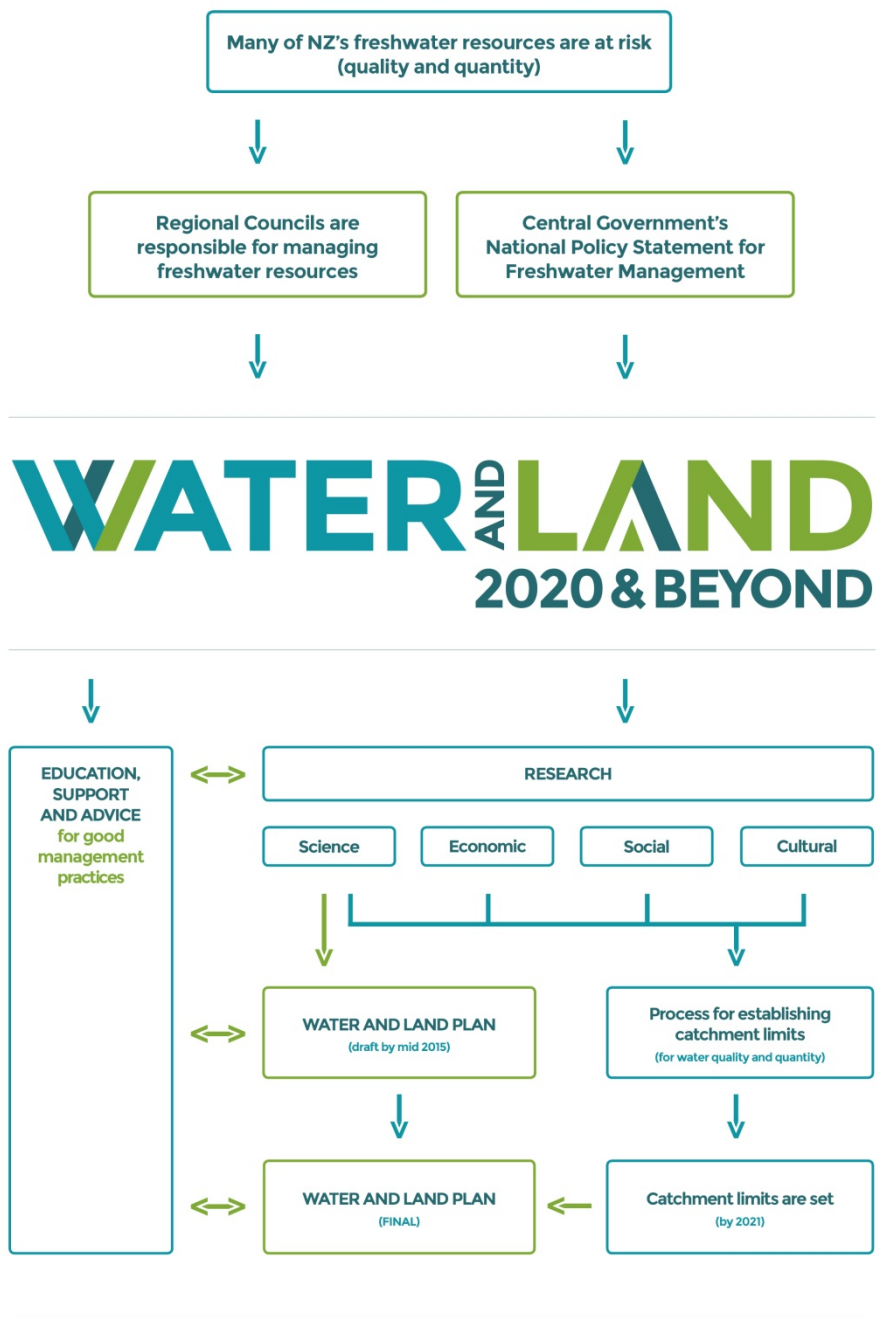
### 1.3 Southland Context

Water quality challenges in Southland echo those of the rest of New Zealand. "Scientific monitoring and investigations confirm that Southland has both water quality and quantity issues" (Environment Southland, n.d.-b)

*"Intensive agriculture has put our natural systems under a pressure that they've never had to cope with before. Environmental pressures from these land use changes can be severe. The large scale loss of indigenous vegetation across the region has accelerated erosion processes, reduced biodiversity and led to the increased sedimentation of the region's water bodies. The recent shift to high nutrient loss, intensive land uses such as dairying, winter cropping and intensive beef and sheep farming has meant that we are seeing significant declines in soil and water quality across the region." (Environment Southland, n.d.-b, para. 6).*

In order to address the water quality issues, Environment Southland responded to the NPS-FW with a Proposed Regional Policy Statement in 2012 and a Proposed Water and Land Plan which was notified in June 2016 and progressed through a public submission and hearing process in 2017.

To support these legislative change processes Environment Southland has also launched a multi-disciplinary project, branded Water and Land 2020 & Beyond. The intention is that the project will help the region build towards limit setting while preparing information and educating constituents about the upcoming changes (Environment Southland, n.d.-c). The Water and Land 2020 and Beyond project recognises that together farmers, iwi, communities, and councils in Southland must find a way to negotiate and produce a workable solution to meet the nationally imposed bottom lines for water quality. Figure 1.1 shows the project structure.



**Figure 1.1 Water and Land 2020 and Beyond.**

(Environment Southland, n.d.-c)

One of the major work streams for the Water and Land 2020 & Beyond project is Education, Support and Advice for Good Management Practices (GMPs). In the lead up to limit setting Environment Southland has been actively promoting the adoption of GMPs, which are methods and actions that can be undertaken on a farm to improve water quality. They include things like:

- Fencing and planting next to waterways;
- Strategically grazing crops to minimise time animals spend on bare soil next to a waterway;
- Choosing which paddocks to plant crops in based on nutrient pathways to water;
- Stabilising stream and river banks to prevent erosion;
- Optimising fertiliser use through soil testing and nutrient budgeting.

As a result of the proposed Southland Water and Land Plan, owners of land greater than 20 hectares in Southland are now required to produce Farm Environmental Management Plans which identify key nutrient loss pathways and farm-specific GMPs for their properties (Environment Southland, n.d.-c).

Between 2011 and 2014 Environment Southland identified five agricultural activities that have the largest impact on water quality in Southland. These activities are:

- Hill and high-country development;
- Nutrient management;
- Intensive winter grazing;
- Overland flow;
- Riparian management.

Based on these activities, a Focus Activity Farm Plan programme was established to educate farmers about property-specific GMPs. Environment Southland's Land Sustainability Officers work in catchments throughout Southland: mapping farms, producing the Focus Activity Farm Plans and delivering environmental advice and practical recommendations to farmers (Environment Southland, n.d.-c).

## **1.4 Science**

The GMPs in the Focus Activity Farm Plans, as well as policies and rules in the recently notified Southland Water and Land Plan, are informed by scientific research into the hydrochemistry of Southland. A research project called the Physiographics of Southland has shed new light on the question of why the same land use activity can have different effects on water quality in different areas. The project grouped land in the region into nine zones according to characteristics that determine the way nutrients build up and move through soil, groundwater, and into streams and rivers. Attributes that characterise and distinguish the zones include:

- Underlying geology;
- Water recharge source;
- Rainfall;
- Soil oxygen levels;
- Soil type;
- Topography.

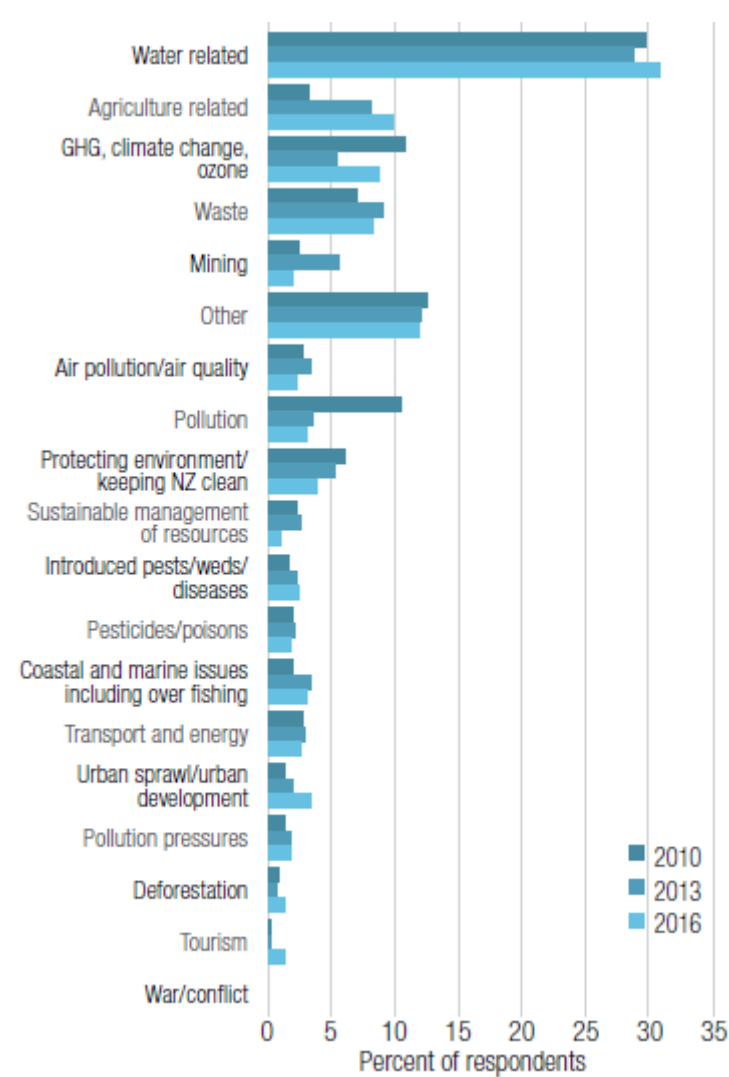
The premise of the physiographic science is that the zones can offer a means to identify water contamination hot spots and provide targeted solutions to problems where they exist, as opposed to generalised regulations and a region wide one rule fits all approach (Environment Southland, n.d.-a).

## 1.5 Social Licence

The water quality issues outlined above have moved beyond the realm of research and expert discussion and are now, more than ever, being debated in the public arena. Media coverage of water quality has put freshwater issues firmly on the national agenda. Articles with headlines such as "Farming Sector Should Face Environmental Responsibilities" (Fish and Game New Zealand, 2017) and "Southland Farmers Dobbing in Neighbours for Dirty Dairying Practices" (Harding, 2017) are now common across New Zealand's media and this increased awareness has led to more demand for environmental reporting and less acceptance of the environmental cost of doing business. Pressure is mounting on farmers and the rural sector to lessen their impact on the environment.

This pressure relates to the concept of social licence. Edwards and Trafford (2016) researched the application of the concept of social licence in New Zealand, finding that the term evolved from corporate responsibility models in the mining industry and that the concept has been in circulation in New Zealand since 2012. In a 2013 report the Sustainable Business Council said "in essence, having a social licence to operate is the ability of an organisation to carry out its business because of the confidence society has that it will behave legitimately, with accountability and in a socially and environmentally responsible way" (Sustainable Business Council, 2013, p. i). The report went on to reference the Lincoln University Public Perceptions of New Zealand's Environment study which, in 2010 found that "water pollution and water related issues were rated as the most important environmental issue facing New Zealand" (Hughey, Kerr, & Cullen, 2010, p. iii). Associated with the water related concern was the continuing increase in negative judgements about farming as a perceived source of pressure on the environment. Over half of the respondents identified farming as one of the three main causes of damage to freshwater and Hughey et al. commented that "over time farming has been perceived as increasingly problematic for almost all resources monitored" (Hughey et al., 2010, p. 48). In the 2013 and 2016 editions of the study (Hughey, Kerr, & Cullen, 2013, 2016)

the water related sentiments remained high and the perception of agriculture related issues increased dramatically. Figure 1.3 shows this below.



**Figure 1.2 Perceived most important issues facing New Zealand – trends over the 2010, 2013, 2016 survey period**

(Source: Hughey, Kerr, & Cullen, 2016, p. 22. Reproduced with permission)

Leaders in the rural sector are keenly aware of the need to manage public perceptions and expectations and maintain their social licence to operate. However, Edwards and Trafford commented that often industries use components of social licence to suit their specific purposes and that not everyone is talking about the same thing when they talk about social licence to operate (SLO) "the choice of meaning or approach to SLO does not always equate to the broad concept of

SLO, nor does it often take into account the ongoing community engagement process that is needed to gain and maintain a SLO" (Edwards & Trafford, 2016, p. 166).

The concept of social licence has recently been acknowledged and publicly addressed by prominent New Zealand rural leaders including:

- Stephen Macaulay - CEO of the New Zealand Institute of Primary Managers;
- Dr William Rolleston - former Federated Farmers President and;
- John Luxton - former Dairy NZ Chairman and former Minister of Agriculture.

All three of these leaders had similar opinions on the theme of a rural-urban divide, suggesting that increasing urbanisation has meant subsequent disconnection and lack of shared understanding between rural producers and urban consumers (Macaulay, 2017; Malthus, 2017; Rolleston, 2016). In 2016 Rabobank published an environmental sustainability report where author Blake Holgate remarks on the rural-urban divide and suggests that "just as consumers need to be told a story about where New Zealand's food comes from and how it's produced, so too must the public, to ensure there is an informed consensus as to what environmental and ethical standards are appropriate for farming in New Zealand" (Holgate, 2016, p. 17).

Regardless of a rural-urban divide, public accountability and acceptability is important for farmers to maintain because farming relies on the continued utilisation of public resources, such as freshwater. The SLO concept is essentially recognising and revaluating the long-held implicit assumption that farming is beneficial for society; therefore, its effects should be tolerated by the public. To what extent the effects will be tolerated is currently being discussed nationally. These conversations are extremely relevant to Southland, and in particular to the upcoming limit setting process which will likely set the scene for formally negotiating and explicitly defining the boundaries of farming's social licence to operate in Southland.



## 1.6 Summary and Significance

Southland farmers are currently operating in a period of uncertainty; they have new rules to contend with, an influx of new information to process and large scale environmental problems to help solve.

The province has a considerable challenge looming as Environment Southland attempts to bring individuals and communities together to set objectives and limits for their water quality. Throughout this process farmers will aim to maintain profitable operations while adapting to new environmental requirements and social expectations.

To help farmers begin to adapt, Environment Southland has been actively promoting adoption of GMPs through investment in the Focus Activity Farm Plan program. This investment is part of the wider Water and Land 2020 & Beyond project which aims to help the region transition towards limit setting. The promotion of GMPs has been an exercise in individual behaviour change and it is likely that further and more significant behaviour changes will be required in order for Southland to meet future water quality and quantity limits.

An examination of Southland farmers' adoption of GMPs will provide knowledge to inform the design of any future behaviour change initiatives in Southland, such as those connected with the limit setting process. This knowledge will be valuable for decision makers, policy makers and extension practitioners as well as for informing future research in the area of pro-environmental behaviour in the agricultural sector. The GMPs that this research will focus on are:

- Fencing stock out of waterways;
- Soil testing for nutrient optimisation;
- Installing culverts or bridges at stock crossings;
- Installing a stock water system;
- Planting next to waterways;
- Protecting and/or enhancing natural swamps/wetlands;

- Implementing a Farm Environmental Management Plan;
- Implementing a Nutrient Management Plan;
- Identifying critical source areas and strategically grazing winter paddocks;
- Installing sediment traps.

The following chapter will cover a review of relevant literature, including behavioural theory and its application to agricultural settings. Chapter 3 will outline the methodology of the research including the conceptual model, research design, implementation and analysis. Chapter 4 presents the results. Chapter 5 discusses the findings in the context of the Southland setting and the reviewed literature before making recommendations for further research and drawing conclusions.

## **Chapter 2**

### **Literature Review**

Considering GMPs as pro-environmental behaviours allows for examination of GMP adoption using existing behavioural theory frameworks. By applying these theoretical constructs, a more detailed understanding of factors that influence GMP adoption can be gained.

#### **2.1 Behavioural Theory**

Human behaviour and the factors that influence it have been extensively studied. There is a vast amount of literature and numerous behavioural theories, which examine and attempt to explain why humans behave the way they do and to predict how they will behave in new circumstances (Darnton, 2008a). These behavioural theories are informed by economics, psychology and sociology and they tend to frame behaviour as a linear, or multi-linear decision making process (Darnton, 2008b).

There has been significant work on behavioural theories to explain pro-environmental behaviours, "concern for the environment has been continuously investigated for four decades. Its study has provided a greater understanding of how individuals relate to their environment as well as the comprehension and possibly inclination towards pro-environmental behaviour" (Rhead, Elliot, & Upham, 2015, p. 175). Theories inform behavioural models which work like maps showing the interactive nature of the many foundations and causes of observable pro-environmental behaviour; they help frame understanding of the multiple and complex reasons behind why people do what they do. Models are also able to offer insight into "where there is scope to influence people towards more pro environmental [sic] behaviour" (Department for Environment, Food and Rural Affairs, 2008, p. 30).

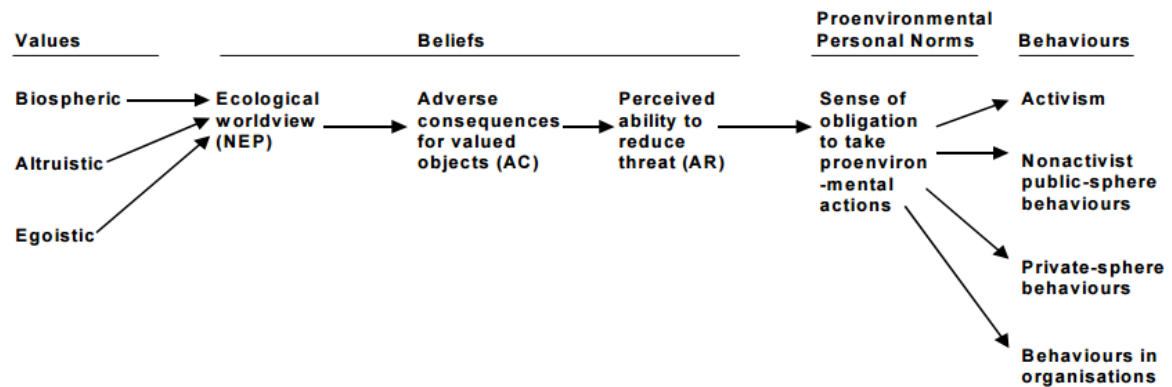
Rhead et al. consider there to be three classic measures of environmental concern which are:

- Ecology Scale (Maloney & Ward, 1973; Maloney, Ward, & Braucht, 1975);
- Environmental Concern Scale (Weigel & Weigel, 1978);
- New Environmental Paradigm (NEP) Scale (Dunlap & Van Liere, 1978).

"These three scales examine multiple phenomena or expressions of concern, such as beliefs, attitudes, intentions and behaviours, and they also examine concerns about various environmental topics, such as pollution and natural resources" (Rhead et al., 2015, p. 176).

Rhead et al. have identified a second wave in the study of environmental concern from the late 1990's onwards. This new wave of research "asks fundamentally different questions and rather than investigating general attitudes about environmental issues seeks to identify underlying *values* that provide the basis for environmental attitudes" (Rhead et al., 2015, p. 176). A significant theory that leads this second wave of research is the value-belief-norm theory of environmentalism (VBN) (Stern, Dietz, Abel, Guagnano, & Kalof, 1999). The VBN was first published in 1999 with the claim that it "provides the best available social-psychological account of nonactivist [sic] support for the goals of the environmental movement" (Stern et al., 1999, p. 91). Three theoretical constructs inform the VBN, these are: norm-activation theory, the theory of personal values, and the NEP. "While the VBN theory is intended to explain behaviour, embedded within it is a theory of environmental concern, specifically the NEP portion " (Rhead et al., 2015, p. 176).

"The VBN postulates that the consequences that matter in activating personal norms are those that are perceived as adverse with respect to whatever the individual values" (Rhead et al., 2015, p. 176). These factors are linked as a causal chain to create the VBN's unified explanation for environmentalism as shown in Figure 2.1.

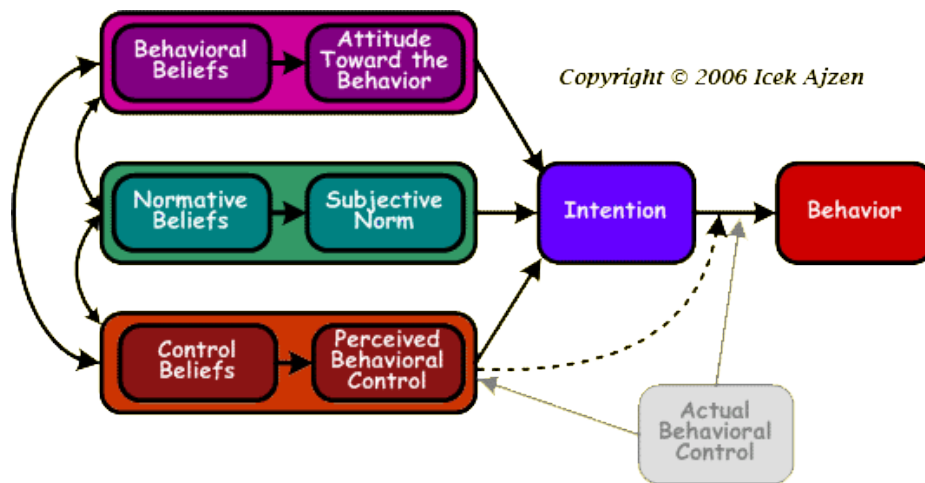


**Figure 2.1 Value Beliefs Norms Model**

(Stern, 2000, p. 412)

As a caveat to the VBN, Stern discussed the complexity of behavioural setting as potentially having major influence on individual capacity for change; stating that "environmentalist predispositions can vary greatly with the behaviour, the actor, and the context" (Stern, 2000, p. 415). Stern defined this as the ABC theory where actions that are required or tangibly rewarded are described as being strongly favoured by context. The ABC theory also states that the "more difficult, time-consuming, or expensive the behaviour, the weaker its dependence on attitudinal factors" (Stern, 2000, p. 415).

Originating from a general behavioural approach, rather than specifically from environmental concern, Ajzen's 1985 Theory of Planned Behaviour (TPB) is an early extended behavioural model. Ajzen built on the Theory of Reasoned Action, which had its roots in adjusted expectancy value models, to incorporate additional behavioural factors which meant that the TPB could account for more of the statistical variance in end behaviours than previous models (Darnton, 2008a, p. 13). The TPB model framework is shown in Figure 2.2.



**Figure 2.2 Theory of Planned Behaviour**

(Ajzen, 2006)

An important difference between Ajzen's TPB and Stern's VBN is that Stern explicitly places values as the foundation of behaviour (Darnton, 2008a, p. 14). In the VBN "values are generally perceived as fairly distal determinants of behaviour which influence behaviour via more proximal determinants, such as beliefs, specific attitudes and norms" (Gatersleben, Murtagh, & Abrahamse, 2014, p. 378).

Because the causal chain of the VBN moves from relatively stable moral foundations to more changeable human factors, beliefs are a key link between values and behaviour in the VBN model. Beliefs are centred on who or what is affected by environmental conditions (AC) and about whether there are individual actions that could alleviate threats to valued persons or things (AR). So, environmental behaviour can be influenced by information that shapes these beliefs (Stern, 2000, p. 414).

Beliefs in the TPB are categorised into behavioural, normative and control and although inter-related, each category of beliefs is modelled to move through intentions to behaviour via different paths, so in the TPB beliefs are relatively distal determinants of behaviour. "The TPB suggests that pro-environmental behaviour is more likely to occur when people have a positive attitude towards such behaviour, believe significant others already do it (perceived descriptive social norm) or believe it

should be done (perceived injunctive social norm) and when they feel they can adopt the behaviour (perceived behaviour control)" (Gatersleben, Murtagh, & Abrahamse, 2014, p. 375).

Norms are components of both the TPB and the VBN, although norms function in quite different ways in these two models. In the VBN pro-environmental personal norms are the final link to behaviour and are "the main basis for individuals' general predispositions to proenvironmental [sic] action"(Stern, 2000, p. 413), whereas in the TPB normative beliefs and subjective norms are factors of behavioural intention.

Ajzen also factored the contextual issues of behaviour into the TPB, via intentions. Because intentions do not always equal actions Ajzen stated "the fact that intentions can change over time forces us to recognise their provisional nature" (Ajzen, 1985, p. 24). Ajzen included a discussion of volitional control and commented that "we can never be absolutely certain that we will be in a position to carry out our intentions" (Ajzen, 1985, p. 24). Internal factors such as: individual differences, information skills and abilities, power of will and emotions and compulsions were suggested by Ajzen (1985) as reasons for intention failing to translate into action. Dependence on others as well as time and opportunity were suggested as external factors that were able to limit action taken. Ajzen stated that "various internal factors influence successful performance of an intended behaviour. It may be fairly easy to gain control over some of these factors. Other factors such as intense emotions, stress or compulsions, are more difficult to neutralise" (Ajzen, 1985, p. 27) while external limitations are only temporary setbacks "with little effect on the underlying motivation" (Ajzen, 1985, p. 29).

Both the TPB and the VBN have elements of relevance to GMP adoption in the Southland farmer setting. Both theories are used to explain individual pro-environmental behaviour; however the VBN focuses on values and moral norms while the TPB focuses on self-interest and rational choices (Kaiser, Hübner, & Bogner, 2005). The decision to base this research on the VBN is because the VBN's

grounding in social movements (Stern et al., 1999) aligns with the social imperative for action on water quality issues in Southland.

## **2.2 Behavioural Theory in Agriculture**

"There is a considerable body of studies on behavioural theory in agricultural decision making; however, there is a big gap in empirical evidence linking behavioural theory and the adoption of, or intention to adopt, a suite of environmental practices" (Small, Brown, & Munguia, 2016, p. 283).

A recent study from the USA, where high-input farm systems are already the norm, puts forward the theory that "all farmers have their own version of what it means to be a good farmer" (McGuire, Morton, & Cast, 2013, p. 57). Farmers' beliefs that they are good farmers are inextricably connected to their self-identity and sense of pride for the products they produce. Further, the study found that "a large number of farmers have conservationist identities within their good farmer identity; however their conservation goals often need to be activated to rebalance the production-conservation meanings they give to their roles in society" (McGuire et al., 2013, p. 57).

McGuire et al. (2013) looked at how performance-based environmental management processes can be used to influence farmer social identity and shift the overall good farmer identity towards a stronger conservationist standard. They found that farmers are operating in a conflicted space which is under increasing public scrutiny. There is a societal expectation for better environmental outcomes as well as a need for a reliable and affordable food supply. This puts competing pressures on farmers to meet demand and expectations while maintaining profitability and ensuring that their business can survive. McGuire et al. (2013, p. 57) note that "there is a body of literature that suggests the productivist identity dominates the decision making process thereby putting water quality and other environmental goals at risk". This suggests that the conservationist identity is secondary, or suppressed, for many farmers.



There are numerous extension, policy and enforcement mechanisms available to regulatory authorities to enable them to achieve environmental targets. Influencing the activation of farmers' conservationist identity is one option for motivating behaviour change to address agricultural water quality issues. Extension programmes, such as Environment Southland's promotion of GMPs are designed to encourage activation of this conservationist identity, because self-motivated behaviour change means less regulatory and enforcement work is required to achieve socially desirable environmental outcomes. However, influencing self-motivation is not straight-forward and "there is much we do not understand about how farmers perceive their role (their "farmer identity") and make trade-off decisions between farm profits and conservation goals. A farmer's person, role, and social identities are complex, dynamic, and often context specific" (McGuire et al., 2013, p. 58).

An Australian study (Sanderson & Curtis, 2016) identifies similar themes around changing pressures in the rural landscape and about farmer identity and its intrinsic connection to natural resource management. This study applied the VBN theory to "construct multivariate models of the relationship between ground water irrigators' interpretations of climate change risks and their implementation of adaptive water conservation practices" (Sanderson & Curtis, 2016, p. 284). Results highlighted the complexity of farmers' decision-making and the array of factors which drive farmers' decisions about on-farm adaptation strategies. Sanderson & Curtis commented that the VBN framework was valid because it "provides an integrated model of decision-making that is flexible enough to incorporate processes linking cultural factors to a range of outcomes, including on-farm decisions" (Sanderson & Curtis, 2016, p. 291).

Sanderson & Curtis were able to show a relationship between mitigative norms and adaptive water management, but commented that "the causal chain is not as straightforward as VBN would postulate" (Sanderson & Curtis, 2016, p. 291). They went on to recommend that "future studies might consider modifying VBN survey questions so they are more tailored to farmer decision-making, because our findings suggest that farmers' VBN decision-making chains are more complex than those

of the general public" (Sanderson & Curtis, 2016, p. 291).

A Swedish VBN study by Johansson, Rahm & Gyllin (2013) examined landowners' participation in biodiversity conservation. Sweden is facing similar challenges to those in New Zealand, that agricultural development has left wetlands and forests severely degraded. Similar to the Focus Activities approach in Southland, farming organisations in Sweden instigated an initiative called 'Greppa Näringen' ('Catch the Nutrients'). It aims to "promote more efficient and environmentally friendly farming techniques, including wetland restoration on farmland" (Johansson et al., 2013, p. 297). Stern's VBN theory was applied to the Greppa Näringen project to get an understanding of the moral obligation of farmers who participated in the voluntary scheme. Results were mixed and implied that psychological motivation alone does not guarantee environmentally significant behaviour (Johansson et al., 2013).

Johansson et al. (2013) emphasised the importance of contextual factors such as age, education, size of land area, and length of ownership for influencing land owners' decisions to take pro-environmental actions. They concluded that contextual factors need to align in order for moral motivations to lead to action. "This means that landowners who hold a moral motivation, as measured by VBN variables, to participate in nature conservation projects will be likely to do so only if contextual factors are also supportive of such behaviour, or at least do not have a strongly negative influence" (Johansson et al., 2013, p. 307). They recommended that future research in this area should incorporate study of the effects of external structural factors such as economic variables. (Johansson et al., 2013, p. 307).

A Taiwanese study by Chen (2015) also applied the VBN to a pro-environmental behaviour context, although it focused on climate change and behaviour at a household level. The study was able to conclude that in their setting "the VBN theory model is robust in predicting pro-environmental

behaviour and implying that personal norms, or the sense of moral obligation to take action, is the ultimate predictor of conservation behaviour" (Chen, 2015, p. 149).

## **2.3 Pro-Environmental Behaviour in New Zealand Agriculture**

In 2013 and 2015 Landcare Research conducted a Survey of Rural Decision Makers (SRDM) across all 16 regions in New Zealand. The 2015 survey is of particular interest because it gathered data on values, norms and preferences as well as land management practice and technology adoption. The results give a break down by region of GMP adoption (Brown, 2015).

Based on the SRDM, Small et al. (2016) examined the values, trust and management of rural decision makers in New Zealand agriculture. They investigated how farmers' value orientations towards production and the environment influenced their adoption of GMPs. Small et al. (2016) found that the value orientations of rural decision makers directly affected adoption and use of GMPs, although the measured differences are relatively small across the whole population and numerous other variables also influence farmer decision making and adoption behaviour. After analysing their results there was no clear evidence about complexity, linearity, or contextual dependence of farmer decisions, but Small et al. speculated that "farmer adoption is complex and non-linear; under different sets of circumstances or conditions, the influence of particular variables on the adoption of good practice may increase or decrease" (Small et al., 2016, p. 303).

In an example from North Canterbury, Duncan (2014) argues that farmers' understandings of the relationship between land and water are different from the scientific framing of the land-water relationship and she states "that acknowledging and recognising how farmers frame the water quality problem is an important starting point for working with them in the implementation of new policies and rules and the achievement of good and best management practice" (Duncan, 2014, p. 18).

Though not yet applied in a New Zealand farming context, Stern's VBN is a proven framework for examining pro-environmental behaviour in agricultural settings. The VBN suggests that farmer perceptions of adverse effects from agriculture could promote their use of mitigation behaviour, such as adoption of GMPs (Chen, 2015).

## **2.4 Tailoring the Research for the Southland Setting**

The issues of context and complexity were covered in many forms throughout the literature reviewed. Sanderson & Curtis (2016) highlighted the complexity of farmers' decision-making and the array of factors which drive farmers' decisions about on-farm adaptation strategies. Johansson et al. (2013) emphasised the importance of contextual factors such as age, education, size of land area, and length of ownership for influencing land owners' decisions to take pro-environmental actions. In a New Zealand context Small et al. speculated that "farmer adoption is complex and non-linear; under different sets of circumstances or conditions, the influence of particular variables on the adoption of good practice may increase or decrease" (Small et al., 2016, p. 303). Johansson et al. concluded that contextual factors need to enable moral motivations to lead to action and recommended that future research in this area should incorporate study of the effects of external structural factors such as economic variables (Johansson et al., 2013, p. 307). These recommendations are relevant for incorporation into the Southland setting because of the likelihood of farmers needing to make trade-off decisions between financial and environmental goals as catchment limits are imposed on them.

Because of the current social imperative for behaviour change around water quality outcomes; understanding possible points of influence for behaviour change (GMP adoption) would be a useful application of this research in the Southland setting. Because changes in beliefs and norms are more proximate to behaviour change they are more likely to be effective targets for influence.

It is possible to concentrate on the beliefs and norm components of behaviour by only using part of the VBN. This has been done before, although not in an agricultural setting. A study from the USA which examined behavioural theories in the context of aquatic invasive species and the role that hobbyists play in the spread of these ((Mayer, Seekamp, Casper, & Blank, 2015) explored VBN constructs but did not include values or the NEP component of beliefs in their model. This is because previous work by Abrahamse & Steg (2011) "demonstrated that the NEP has not had a direct effect on behavioural intention when other VBN constructs are included in the model" (Mayer et al., 2015, p. 69). This means that values of individual farmers do not necessarily have to shift to change their behaviour.

## Chapter 3

### Methodology

#### 3.1 Conceptual Model

This research adopted a postpositivist worldview (Creswell, 2014) and took a quantitative empirical approach to measuring farmers' norms and their beliefs around the relevance and effectiveness of agricultural GMPs on their properties for improving local and regional water quality outcomes.

As per the work by Mayer et al. (2015), a modified version of the VBN theory of behaviour (mBN) was chosen to examine how farmers' beliefs and norms impact adoption of GMPs in Southland (Figure 3.1).

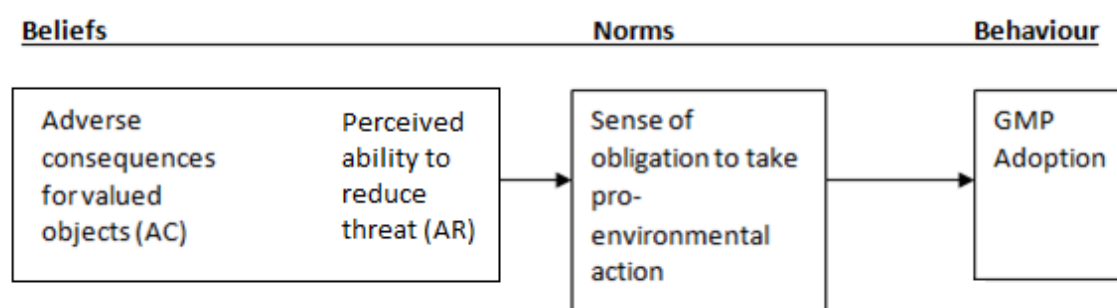


Figure 3.1 Modified Beliefs and Norms Model (mBN)

## **Research Objectives**

1. Measure farmers' beliefs.
2. Measure farmers' subjective norms.
3. Measure farmers' adoption of GMPs.
4. Apply the mBN Theory to test the effects of 1 and 2 on 3.

## **3.2 Research Design**

An online survey was created and hosted using the Qualtrics platform. Survey questions were designed to gather data on the beliefs and norms components of the mBN. The question design was informed by the literature reviewed, and questions were structured around 10 farm specific GMP behaviours from Environment Southland's GMP factsheet (Environment Southland, 2016).

The survey questions were strategically structured to prevent pro-environmentally biased answers, following the methodology of Steg, Dreijerink, & Abrahamse (2005, p. 417). There were 4 key questions that addressed the mBN. Firstly, asking about farmers own behaviour, then asking about their perceptions of others' behaviour (norms) and thirdly asking how effective they thought those behaviours were (AR). Following these three questions farmers were asked to state the relevance of each practice to their farm (AC), or to identify factors that constrain their adoption. Following the recommendations of Johansson et al. (2013) and Sanderson & Curtis (2016), additional survey questions captured demographic information about the farm and the farmer. The survey questions are in Appendix A.

The survey was designed to take less than ten minutes to complete. Prior to launching the project, the survey was pretested by staff at Environment Southland and by a small group of farmers to get feedback about timing, wording, information accuracy and survey functionality.

## **Ethical Considerations**

The introduction to the survey made it clear that participation was not compulsory and that it was possible to withdraw from the study at any time up until results were collated. There was no deception of participants and anonymity was guaranteed. Participants were required to give informed consent before undertaking the survey. Wording of the survey was carefully chosen to ensure neutrality. The word “good” and the term “good management practices” were excluded from the survey to ensure that no farmers were made to feel negatively about not undertaking GMP behaviours. Ethical approval was gained from the Lincoln University Human Ethics Committee prior to distribution of survey invitations.

## **3.3 Participant Recruitment**

The sample population was farmers in Southland; the size of this population was estimated to be between 6,000 to 10,000 based on 2013 census data (Grant, 2015). The flyer distribution service offered by the rural postal network was a key tool to define and access the sample population. In total there are 7,118 farm mail boxes in Southland, excluding Queenstown and Glenorchy but with the inclusion of some in Tapanui where the delivery run crosses into Otago (I-cue, 2016). Because of the ability to access an entire population relatively cheaply through rural flyer delivery, census sampling and cluster sampling were the sampling methods considered. Census sampling covers every single person in a defined population, whereas cluster sampling utilises the natural groups present and surveys groups as whole clusters within populations (O’Leary, 2014). Census was chosen as the sampling method because it is more regionally representative.

## **Leaflet**

A leaflet was distributed to every rural letterbox in Southland via the Rural Delivery mail service. This leaflet invited participants to complete an online, self-administered survey. The leaflet introduced



the research; provided a QR code along with a URL to a survey website and an invitation to complete the survey. Language on the invitation leaflets was tailored to ask for help, rather than demand participation. The graphic design elements were crafted to make the leaflet visually appealing with punchy, uncluttered messaging that was aligned with the rural sector. Grass was chosen as the visual component because it is an important factor in all farming sectors and is seen as quintessentially rural.

The leaflet had prominent Lincoln University branding on the front as well as the Logo of Te Anau Helicopter Services printed on the back, this tied in with the advertised incentive of a helicopter flight for two in Fiordland, drawn from survey respondents. Research information and researcher contact details were provided on the back of the leaflet. The leaflet was A6 size, printed in colour on the front and black and white on the reverse. These design considerations were informed by O'Leary (2014, Chapter 11). The leaflet is in Appendix B.

## **Website**

A website was set up as a landing page to link between the leaflet and the Qualtrics survey site. The website was hosted by WordPress and had the same branding and visual design elements as the flyer, it also provided the same contact information and the site was designed to function on desktop browsers, and mobile devices.

## **Incentive**

As an incentive to complete the survey, the chance to win a helicopter flight for two people was offered. The flight was purchased from Te Anau Helicopter Services. This prize was drawn randomly from respondents who chose to enter their contact details in the draw.

### **3.4 Data Collection**

The survey was active from Monday July 3rd until Friday August 4th 2017. The surveys were self-administered and responses were collected and stored within Qualtrics. Three quarters of the responses came in the first ten days after the leaflets were distributed and 10.51 minutes was the average time taken to complete the survey.

### **3.5 Data Analysis**

Once collected, data were exported from Qualtrics then cleaned, screened and sorted in Excel before being imported into SPSS and AMOS for analysis. Missing values were coded -999 and all duplicate responses were removed for cases where the IP address, the individual demographic information and contact details were identical. From 7118 leaflets sent, there were 135 responses to the survey. Once duplicates were removed there were 132 responses that were included in the analysis, a response rate of 1.8%.

Descriptive statistics were run to describe the demographic and geographic makeup of the sample population. Validation comparisons were then made with data from Environment Southland and Statistics New Zealand.

For the mBN component, structural equation modelling (SEM) was chosen as the analysis method because of its ability to measure both direct and indirect effects, such as the effect of beliefs on behaviour (Schreiber, Nora, Stage, Barlow, & King, 2006). Before proceeding with SEM, data were tested for assumptions of normality and multicollinearity, following recommendations by Schreiber et al. (2006). VIF scores indicate that multicollinearity is not an issue for this data set; however, normality of the data was not ideal and could potentially compromise the model fit in some cases.

Listwise deletion of missing data ensured that the analysis was representative of the sample and not biased by estimated data.

SEM was carried out using AMOS, to test how well beliefs and norms could predict behaviour for each of the ten individual GMPs. To ensure significance of results was not overestimated the Bonferroni correction was applied. The outputs of the SEMs were then analysed in the context of the setting and the literature. Results are reported in Chapter 4 and discussed in Chapter 5.

### **3.6 Limitations**

Time and financial resources were two key factors that limited what was feasible with the research scope and design. With more time the research could have expanded to incorporate additional dimensions such as a qualitative interview based component to aid understanding of context, trade-offs and farmer decision making. With more financial resources, greater effort could have gone into recruiting and reminding participants, thereby achieving a larger and more representative sample.

Access to and knowledge of technology was a limiting factor that was considered in the design phase. Some rural areas of Southland do not yet have affordable and reliable internet connections and some farmers have not adopted digital technology. The use of an online survey limits participation of these groups and is likely to have introduced non-response bias (O'Leary, 2014, p. 216) towards younger and digitally connected farmers. Given logistical constraints, it was not possible to use a postal survey, which may have mitigated these biases. Defining and accessing the population was a limiting factor for other data collection methods that were considered. Given the access to the entire population via the postal network and the minimal imposition on respondents and researcher time, physical invitations to online surveys were considered the most suitable approach for the constraints of the research setting.

Finding validation data was also a limitation. There are no known records of Southland farmer demographic information. This meant that validating the survey data was limited to inference from general regional statistics.

## Chapter 4

### Results

#### 4.1 Descriptive Statistics

##### Farm Type, Size and Location

**Table 4.1 Main Farm Type**

Main Farm Type	Number of responses	Percent of all respondents
Sheep	59	46.8%
Beef	13	10.3%
Dairy	31	24.6%
Cropping	7	5.6%
Dairy Support	7	5.6%
Deer	2	1.6%
Other	7	5.6%

57.1 % of the respondents were from sheep and/or beef properties (n=72). Dairy farmers made up 24.6% of respondents (n=31), and deer farmers were 1.6% of respondents (n=2). These proportions are broadly similar to the distribution of farm types in the Environment Southland Land Use Map (Pearson, 2017), summarised in Table 4.2.

**Table 4.2 Southland Farm Types and Sizes. Source: Pearson (2017)**

Farm type (>40ha)	Number of farms	Mean size (ha)	Percent of all farms	Percent of area
All farms	3456	321	100%	100%
Dairy (milking platforms)	919	235	27%	19%
Sheep & beef	1974	395	57%	70%
Deer	218	198	6%	4%

The mean farm size across all sectors, according to Environment Southland land use map data was 321ha; this excludes data from farms smaller than 40ha (Pearson, 2017). The most common farm size category in the survey was 201-500ha, which aligns with the 321ha mean. Survey responses were distributed across all sizes of land holding as shown in Table. 4.3.

**Table 4.3 Farm Size**

Farm Size	Number of responses	Percent of all respondents
0-40ha	19	15.2%
41-200ha	30	24.0%
201-500ha	45	36.0%
501-1000ha	19	15.2%
1000ha+	12	9.6%

Farms from right across Southland are represented and the two largest catchments, the Mataura and the Oreti, had the largest number of respondents as shown in Table 4.4.

**Table 4.4 Farm Location**

Farm Location	Number of responses	Percent of all respondents
Te Anau Basin	10	8.3%
Upper Mataura	26	21.7%
Lower Waiau	11	9.2%
Oreti	35	29.2%
Aparima	19	15.8%
Lower Mataura	19	15.8%

### **Farmer Position, Experience, Age and Education.**

Together, farm owner-operators and farm managers made up 82.3% of respondents. Farm owner-operators alone were almost three quarters of the respondents with 72.6% representation. It is notable that there was minimal representation in the survey population from farm employees, as shown in Table 4.5.

**Table 4.5 Position on Farm**

Position on Farm	Number of responses	Percent of all respondents
Owner-operator	82	72.6%
Manager	11	9.7%
Equity Partner	3	2.7%
Farmhand	4	3.5%
Offsite Owner	2	1.7%
Sharemilker	8	7.1%
Lease Holder	1	0.9%
Stock Manager	1	0.9%
Other	1	0.9%

The large majority of respondents had more than 10 years farming experience, and 40.7% of respondents reported having more than 30 years farming experience (Table 4.6).

**Table 4.6 Farming Experience**

Farming Experience	Number of responses	Percent of all respondents
0-5 years	11	9.7%
6-10 years	10	8.9%
11-20 years	24	21.2%
21-30 years	22	19.5%
30+ years	46	40.7%

Exactly half of respondents were aged 45-64 and 37.5% were aged between 25 and 44 (Table 4.7).

**Table 4.7 Farmer Age**

Farmer Age	Number of responses	Percent of all respondents
16-24	6	5.4%
25-34	19	17.0%
35-44	23	20.5%
45-54	27	24.1%
55-64	29	25.9%
65-74	6	5.4%
75+	2	1.8%

Over one third of respondents had a tertiary qualification (Table 4.8), with 28.5% holding a bachelor's degree and 7.1% with a postgraduate qualification. 12.5% had no formal qualification and 18.7% had completed a high school level or equivalent qualification.

**Table 4.8 Highest Level of Education**

Highest Level of Education	Number of responses	Percent of all respondents
No Qualification	14	12.5%
Level 1	9	8.0%
Level 2	13	11.6%
Level 3	5	4.5%
Level 4, 5 or 6	25	22.3%
Bachelor	32	28.6%
Postgraduate	8	7.1%
Masters	2	1.8%
Overseas School	3	2.7%
Not sure	1	0.9%

#### 4.1.2 Comparison to Southland Census Statistics

Education and age were compared with regional data from the New Zealand Census. The Southland regional statistics are measures of the general population within the region, whereas the survey was targeted specifically to sample Southland farmers. Note that the age brackets are not perfectly aligned. For ethical reasons the survey only sampled respondents aged 16 years and older and the census data begin at 15, so 15 year olds are included in the census data but not in the survey population; although this difference should be mitigated by the fact that 16 is the legal school leaving age and there should be no farmers under this age.

The respondents had significantly higher levels of education than the general public, and higher proportions in the 35-44, 45-54 and 55-64 age categories. Chi-squared tests on the education and age data confirm the statistical significance of differences between the survey data and the census data; these are reported in Appendix C.



### 4.1.3 GMP Uptake

Five of the ten GMPs were reported to be used on the majority of applicable farms (Table 4.2). Soil testing for nutrient optimisation, installing a stock water system, fencing stock out of waterways, installing culverts or bridges at stock crossings and identifying critical source areas and strategically grazing winter paddocks all had greater than 60% uptake. Installing sediment traps and implementing farm environmental management plans were the two activities with the lowest uptake when applicability is taken into account.

**Table 4.9 GMP Uptake by survey respondents**

<b>GMP Uptake</b>			
	Already Doing it	Not Applicable to Farm	Uptake on all Applicable farms
Soil testing for nutrient optimisation	68.18%	3.03%	70.31%
Installing sediment traps	25.76%	21.97%	33.01%
Installing a stock water system	70.45%	4.55%	73.81%
Implementing a Farm Environmental Management Plan	34.09%	6.82%	36.59%
Fencing stock out of waterways	62.12%	8.33%	67.77%
Planting next to waterways	43.18%	8.33%	47.11%
Implementing a Nutrient Management Plan	44.70%	4.55%	46.83%
Protecting and/or enhancing natural swamps/wetlands	33.33%	31.06%	48.35%
Installing culverts or bridges at stock crossings	66.67%	12.88%	76.52%
Identifying critical source areas and strategically grazing winter paddocks	68.94%	10.61%	77.12%

Implementing a Farm Environmental Management Plan had not yet been considered by 28.46 % of respondents on applicable farms, 10.57 % thought that it would take too much time or effort and a further 4.07 % thought it would cost them too much money (Table 4.3 –percentages exclude

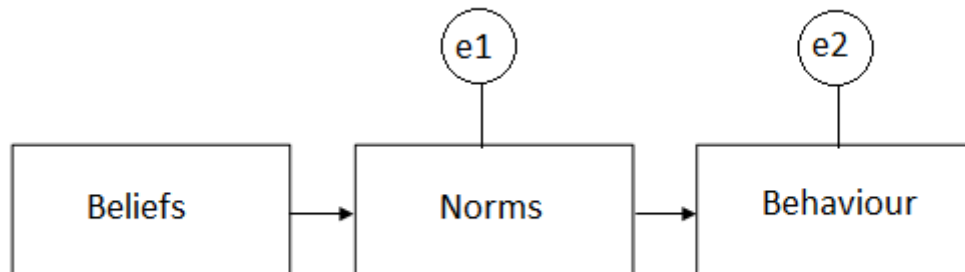
inapplicable farms). Installing sediment traps and implementing a nutrient management plan were the other GMPs with relatively high percentages of respondents who hadn't thought about them yet. Interestingly, cost was identified as a barrier by fewer than 15 % of respondents, except for planting and fencing next to waterways.

**Table 4.10 GMP Limitations on Applicable Farms**

<b>GMP Limitations on Applicable Farms</b>			
	Costs too much money	Takes too much time/effort	Haven't thought about it yet
Soil testing for nutrient optimisation	9.38%	2.34%	4.69%
Installing sediment traps	13.59%	6.80%	27.18%
Installing a stock water system	11.11%	2.38%	1.59%
Implementing a Farm Environmental Management Plan	4.07%	10.57%	28.46%
Fencing stock out of waterways	17.36%	5.79%	0.83%
Planting next to waterways	18.18%	4.96%	7.44%
Implementing a Nutrient Management Plan	3.97%	7.14%	24.60%
Protecting and/or enhancing natural swamps/wetlands	13.19%	5.49%	8.79%
Installing culverts or bridges at stock crossings	8.70%	0.00%	0.87%
Identifying critical source areas and strategically grazing winter paddocks	0.85%	0.85%	4.24%

## 4.2 SEM Analysis

Analysis using SEM was carried out to identify how well beliefs and social norms could predict GMP adoption by Southland farmers. The structure for this modelling is shown in Figure 4.1.



**Figure 4.1 Structural Equation Model Template: mBN Model**

Using this model, each of the 10 GMPs was modelled individually and a Bonferroni Correction was applied to estimated P-values to ensure that significance of individual relationships was not overestimated. The hypothesis tested was that higher belief scores would result in higher norm scores, and higher norm scores would result in increased adoption of GMPs, so positive signs were expected on estimated regression coefficients between (i) beliefs and norms and (ii) norms and behaviour. Results are shown in Table 4.11.

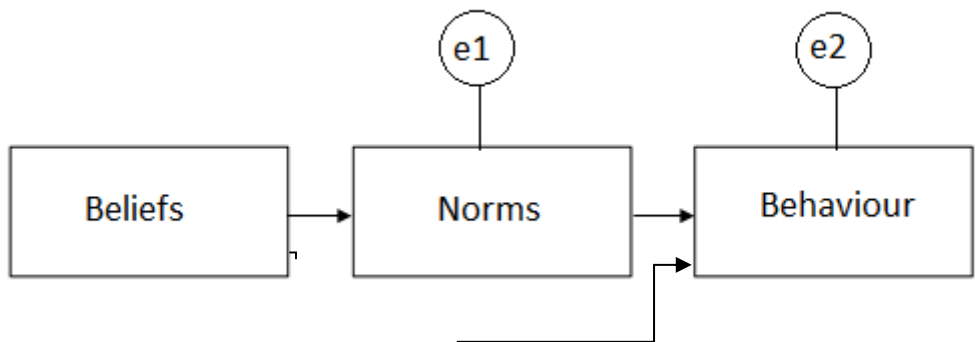
**Table 4.11 Results: mBN Model**

	Fencing	Soil Test	Crossings	Stock Water	Planting	Wetlands	FEMP	NMP	CSA	Sediment	Acceptance Criteria
Sample Size	87	79	82	95	71	55	49	56	74	42	
<b>Model Fit Measures</b>											
CMIN/DF	16.74	6.65	6.80	8.92	10.60	5.45	7.71	8.74	14.37	7.46	<5 (Schumacker & Lomax, 2004)
RMSEA	0.43	0.27	0.27	0.29	0.37	0.29	0.37	0.38	0.43	0.40	<.08 (Hu & Bentler, 1999).
<b>Multicollinearity Measure</b>											
VIF	1.08	1.01	1.00	1.03	1.09	1.10	1.14	1.14	1.07	1.01	< 5 (Hair et al., 1995)
<b>Standardised Betas</b>											
Bel to N	.244(.008)	.112(.296)	(-).008(.937)	.162(.083)	.221(.011)	.216(.021)	.349(.009)	.338(.005)	.251(.027)	.108(.474)	P<.005 with Bonferroni correction applied
N to Beh	.444(.001)	.373(.001)	.349(.001)	.558(.001)	.678(.001)	.509(.002)	.498(.003)	.450(.001)	.267(.005)	.627(.001)	

### Explanation of GMP Abbreviations

Fencing	Fencing stock out of waterways
Soil Test	Soil testing for nutrient optimisation
Crossings	Installing culverts or bridges at stock crossings
Stock Water	Installing a stock water system
Planting	Planting next to waterways
Wetlands	Protecting and/or enhancing natural swamps/wetlands
FEMP	Implementing a Farm Environmental Management Plan
NMP	Implementing a Nutrient Management Plan
CSA	Identifying critical source areas and strategically grazing winter paddocks
Sediment	Installing sediment traps

Because of the poor model fit and the lack of significant correlation between beliefs and norms, an additional direct link between beliefs and behaviour was tested to investigate the relationship between these two variables without the moderating effect of norms. The SEM model was adapted as shown in Figure 4.3.



**Figure 4.2 Structural Equation Model: Adapted mBN Model**

Again, each of the 10 GMPs was modelled individually and a Bonferroni Correction was applied to estimated P-values. Results are shown in Table 4.12.

**Table 4.12 Results: Adapted mBN Model**

	Fencing	Soil Test	Crossings	Stock Water	Planting	Wetlands	FEMP	NMP	CSA	Sediment	Acceptance Criteria
Sample Size	87	79	82	95	71	55	49	56	74	42	
Model Fit Measures											
CMIN/DF	16.74	6.65	6.80	8.92	10.60	5.45	7.71	8.74	14.37	0.75	<5 (Schumacker & Lomax, 2004)
RMSEA	0.43	0.27	0.27	0.29	0.37	0.29	0.37	0.38	0.43	0.40	<.08 (Hu & Bentler, 1999).
Multicollinearity Measure											
VIF	1.08	1.01	1.00	1.03	1.09	1.10	1.14	1.14	1.07	1.01	< 10 (Hair et al., 1995)
Standardised Betas											
Bel to N	.277(.008)	.118(.296)	(-).009(.937)	.176(.083)	.292(.011)	.300(.021)	.354(.009)	.351(.005)	.251(.027)	.111(.474)	P<.005 with Bonferroni correction applied
N to Beh	.303(.001)	.342(.001)	.427(.001)	.398(.001)	.410(.001)	.325(.011)	.253(.051)	.297(.014)	.164(.078)	.524(.001)	
Bel to Beh	.474(.001)	.275(.006)	.204(.037)	.195(.034)	.270(.010)	.206(.110)	.398(.002)	.359(.003)	.578(.001)	.319(.008)	
Standardised Total Effects											
Bel to Beh	0.56	0.32	0.20	0.27	0.39	0.30	0.49	0.46	0.62	0.38	

## **Chapter 5**

### **Discussion**

#### **5.1 Model Analysis**

As discussed above, the mBN model of behaviour is theorised as a causal chain where beliefs influence behaviour through norms. This model was tested on a sample of Southland farmers and was shown to be a poor fit. The mBN was then adapted and results from the surveyed population suggest the potential significance of an independent pathway from beliefs to behaviour without the moderating effect of norms. Although both the hypothesised mBN models were poor fits to the observed data, individual components of the model were significant and these are examined below.

##### **Beliefs to Norms**

For the GMPs surveyed, almost all coefficients were positive as expected. In all cases except for nutrient management plans there was no significant relationship between beliefs and norms. A possible reason for this is the limited scope of the norms question in the survey. The question asked "In your opinion, how many other farmers in your area use the following management practices on their properties?" By structuring the question in this way, it was more inclined towards social rather than personal norms. This is an important difference as in the VBN Stern defines norms as personal, describing them as the "sense of obligation to take pro-environmental actions" (Stern, 2000, p. 412) and stating that "such norms create a general predisposition that influences all kinds of behaviour taken with pro-environmental intent" (Stern, 2000, p. 413). Stern's personal definition of norms is broad in contrast with Ajzen's social definition of norms in the TPB. Ajzen defines a subjective norm that is based around approval or disapproval from important referents and the social desirability of attempting behaviours. (Ajzen, 1985, p. 32). Thus, the content of the question was more in line with the TPB than the VBN and was too narrow to capture the extent of norms that were intended in the

mBN model. Explanatory power of the model might have been improved with a question that was targeted to a more personal interpretation of norms.

### **Norms to Behaviour**

Even with the limited social interpretation of norms, the regression coefficients between norms and behaviour were highly significant for all 10 GMPs in the straight mBN model and 6 out of 10 of the GMPs in the adapted mBN model. In the adapted model the exceptions were: wetlands, FEMP, NMP and CSA, and for three of those (FEMP, NMP, CSA) direct links from beliefs to behaviours were non-significant.

### **Beliefs to Behaviour**

In the adapted model beliefs had a significant effect on behaviour for 4 out of 10 of the GMPs studied. The behaviours with significant results were: fencing, FEMP, NMP and CSA.

In the adapted model fencing was the only GMP that had direct links from both norms and beliefs to behaviour however the link between beliefs and norms was non-significant. This will be applied to the Southland setting and discussed further below.

### **Beliefs and Norms as Intervention Points for Behaviour**

The results above suggest that both beliefs and norms could be useful components to target when attempting to influence behaviour change. This will be considered in the Southland context and discussed further below.



## 5.2 Model Application

As introduced in Chapter 1, Environment Southland has been delivering the Focus Activity Farm Plan program and promoting GMP adoption as part of its Water and Land 2020 and Beyond project; which begins to address the water quality issues in the region as Southland moves towards a limit setting process. This section will examine how beliefs and norms could be utilised as strategic intervention points to increase GMP adoption for improved water quality outcomes in Southland.

### Beliefs to Behaviour

When a direct link was added, the four GMPs that showed a significant connection between norms and behaviour were: fencing, FEMP, NMP and CSA. These four activities are recently introduced requirements as part of Environment Southland's 2016 proposed Water and Land Plan.

For FEMP, NMP and CSA, the connection from beliefs was the only significant link to behaviour. For fencing, both beliefs and norms had significant connections to behaviour but beliefs did not influence norms. This could be because fencing stock out of waterways is an established practice in some types of farming, e.g. dairy, but is a relatively new requirement in others, e.g. deer, sheep and beef.

Focus Activity Farm Plans are Environment Southland's version of FEMPs, which highlight current and future opportunities for implementing farm specific GMPs. Environment Southland has been promoting FEMPs since 2014 and they became a requirement in 2016. The results of this research show comparatively low uptake for FEMPs on applicable farms (36.6%) and 28.5% of respondents reported that they have not yet thought about implementation of FEMPs. In the adapted mBN model there was no significant correlation between norms and FEMP implementation but beliefs had a significant effect on FEMP implementation.

Like FEMP, nutrient management planning (NMP) is a relatively new GMP in Southland which builds on the requirement for an Overseer nutrient budget introduced in the 2016 pSWLP. NMP had 10% more reported uptake than FEMP and similar levels of respondents (24.60%) had not yet thought about implementation. Cost and effort were identified as barriers to adoption by similar percentages of respondents across both practices. It is notable that both NMP and FEMP are largely paperwork exercises rather than practical farming tasks and may require external assistance to complete, which could be a factor of the relatively low uptake.

In comparison, identifying critical source areas and strategically grazing winter paddocks (CSA) is a very practical farming task which requires little to no external input. CSA had the highest uptake of all 10 GMPs surveyed. Reported CSA adoption was high (77.12%) and identified barriers were minimal. This GMP has been widely promoted since the release of a Dairy NZ funded study in 2013 (Orchiston, Monaghan, & Laurenson, 2013). Like FEMP and NMP, the norms component did not have a significant effect on CSA behaviour when a direct link from beliefs was added. This could be because FEMP, NMP and CSA are all relatively new practices and may not have had time to establish as norms; reflecting the dynamic and responsive nature of farming and/or the potential bias of the sample dataset as early adopters of new technology (Rogers, 2010).

The significance of the direct link between beliefs and behaviour is the possibility that positively influencing beliefs about new environmental practices may lead directly to increased adoption of these practices.

### **Norms to Behaviour**

As there is already a direct link between norms and behaviour in the mBN model, and because the results show significant correlations between norms and behaviour in most cases, there is also potential for influencing norms to prompt increased GMP uptake, although the limitation of the social rather than personal interpretation of norms in the question needs to be kept in mind.

## **Complexity of Application**

The additional direct link between beliefs and behaviour supports Sanderson and Curtis' observation that in the farming context "the causal chain is not as straightforward as the VBN would postulate" (2016, p. 291). Sanderson and Curtis suggested that "farmers' VBN decision-making chains are more complex than those of the general public" (2016, p. 291). Small et al. add to this by speculating that "farmer adoption is complex and non-linear; under different sets of circumstances or conditions, the influence of particular variables on the adoption of good practice may increase or decrease" (Small et al., 2016, p. 303).

As McGuire et al. stated, "there is much we do not understand about how farmers perceive their role (their "farmer identity") and make trade-off decisions between farm profits and conservation goals. A farmer's person, role, and social identities are complex, dynamic, and often context specific" (McGuire et al., 2013, p. 58).

The limited contextual information gathered in this research was not enough to understand these complex interactions in full and, in particular, more research is required to explore the AR component of the mBN model, specifically how environmental GMPs are constrained or enabled within farm systems. This research went some way to identifying barriers to GMP adoption with the matrix of limitations in question 11 of the survey. However, the results were not particularly insightful because of limited variability in response resulting from the majority of respondents reporting that they were already implementing GMPs, where applicable, on their properties. Compounded with the small sample size, the ability of this research to identify the constraints on GMP adoption for non-adopters is limited. Further research that could engage those who have not yet adopted GMPs would provide better information. Gaining this knowledge could help to inform the design of solutions that are achievable and beneficial for farmers and water quality outcomes.

### **5.3 Limitations**

Missing data was a limitation that was addressed with listwise deletion of missing cases. This resulted in relatively small sample sizes which were at the low end recommended for SEM (Bentler & Chou, 1987). The alternative was to include all missing data and run the models with AMOS FIML estimations. However, in some cases this would have meant that over half of the data points were being estimated. In order to more accurately reflect the views of the sample, the conservative approach of listwise deletion was employed.

It is important to note that the findings discussed are based on data from a small, self-selected and potentially biased, sample. This means the results are not directly generalisable to the wider Southland farmer population. However, given the lack of existing social research specific to the Southland farmer setting, the learnings from this study are relevant as a starting point for building understanding and can serve to inform future research or extension as long as the limitations of the data are acknowledged.

## **5.4 Recommendations for Future Research**

### **Farmer Engagement**

As discussed in section 5.2, for both future research and any possible extension work, consideration is needed on how to better define, access and engage with the Southland farmer population, particularly the non-responders. This would be a valuable exercise given the current limitations which were covered in section 3.6.

### **Incorporating Complexity**

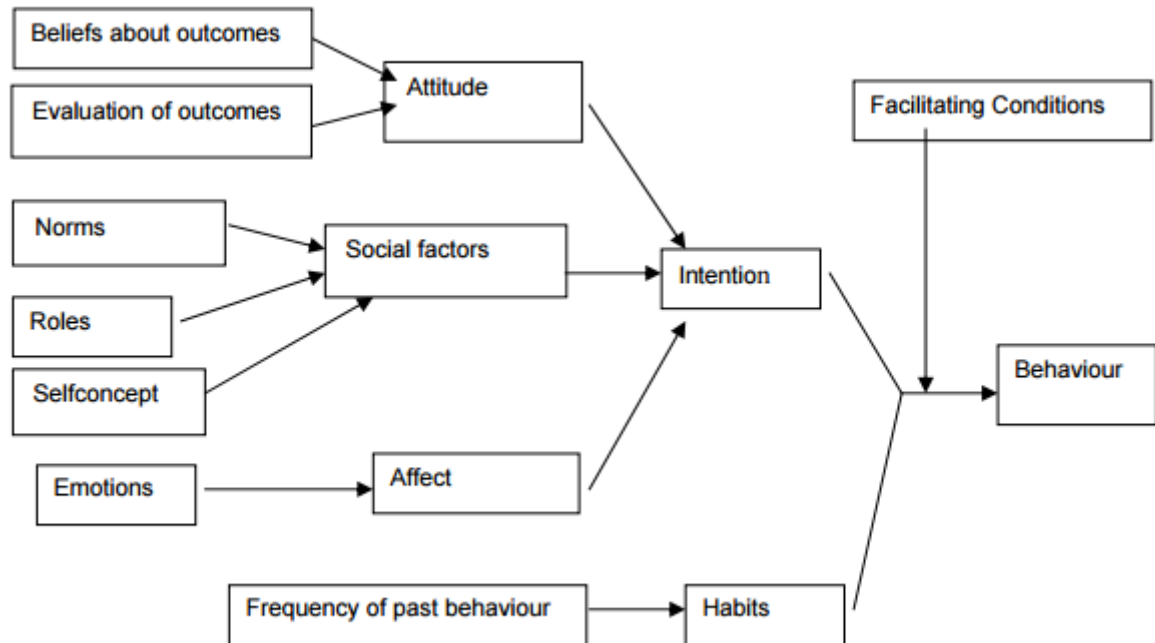
Further research to understand external structural factors, as recommended by Johansson et al. (2013, p. 307), would likely add depth of understanding about farmers' adoption of GMPs. This research did not investigate external structural factors, for the reasons set out in the limitations section (section 3.6). However, they are worthy of future investigation. As discussed in section 5.2, more research is required to explore the AR component of the mBN model, specifically how adoption of environmental GMPs is constrained or enabled within farm systems.

### **Alternative Models**

Options for incorporating complexity include the use of alternative models which capture external factors. In this setting the two models that potentially capture greater complexity are Ajzen's TPB and Triandis' TIB.

Ajzen's TPB was outlined in section 2.1. Triandis' TIB is "an adjusted expectancy value model, like the TPB (which it predates), but through the inclusion of habit, it offers an alternative view to that put forward by the TPB, of behaviour as the result of a solely deliberative process" (Darnton, 2008a, p. 22). Unlike Stern and Ajzen, Triandis saw habit as a primary driver of behaviour. The TIB is a two-

pronged model with both intention and habit influencing behavioural outcome (Darnton, 2008a, p. 22). The TIB model is shown in Figure 5.1.



**Figure 5.1 Theory of Interpersonal Behaviour**

(From Centre for Renewable Energy Sources and Saving, n.d)

Both the TPB and TIB offer alternative models, where barriers to adoption are more explicitly factored into the model design (through facilitating conditions) than in the VBN. The TIB has a broader social component of behavioural intention than TPB does, which could be important for understanding individual behavioural choices related to public resources, such as in the water quality debate.

## 5.5 Conclusion

This research showed that farmers' beliefs and norms had varying degrees of impact on adoption of the 10 individual GMPs that were tested. The most important finding was the direct connection from beliefs to behavioural outcome, which was significant for recently introduced GMPs in the Southland setting. The research also demonstrated a significant connection between norms and GMP adoption in most cases.

This shows that both beliefs and norms have potential as separate strategic points of direct influence for increasing adoption of pro-environmental behaviour. However, this relies on the ability to change beliefs and norms; distinct from merely identifying significance of connection. Before undertaking any behaviour change work, cost benefit analysis would be beneficial to assess whether such effort would be justified.

Further research is also recommended to engage with a broader farming audience to gain data and insights from the full spectrum of adopters and non-adopters. An additional recommendation is employing alternative, non-linear models to increase the level of complexity captured and better understand the intricacies of how GMP adoption integrates with the wider challenges farmers face.

## Appendix A

### Survey Questions

Q1

Hello

Thanks for taking part in this survey, your input is really valuable.

As explained on the leaflet, this research project looks at on-farm management practices and their connection to water quality in Southland. You will be asked various questions related to these topics and I estimate this survey will take 5 to 10 minutes to complete.

Your identity and data will remain private. No one will have access to this information, other than me, my supervisor and, in the event of an audit, the Lincoln University Human Ethics Committee. To further ensure anonymity, survey data will be seen only by me and will be stored with secure password protection. Only aggregated data will be presented in any publications and no information will be reported in a way that might identify any individual participant.

You may withdraw any information you have provided, at any time up to August 5 2017. You can do this by contacting me using the email address below. If you have any queries or concerns about your participation in the project, please contact me using the details below.

Researcher: Sarah-Jane Luoni email: Sarah-Jane.Luoni@lincolnuni.ac.nz

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Q2 I have read and understood the description of the project.

On this basis I agree to participate in the project, and I consent to publication of the results of the project with the understanding that my anonymity will be preserved. I understand also that I may withdraw from the project, including withdrawal of any information I have provided, up to August 5 2017.

☐ Yes, I want to continue

☐ No, I choose not to participate

*Skip To: End of Survey If I have read and understood the description of the project. On this basis I agree to participate... = No, I choose not to participate*



Q3 What is the main farming activity on your property?

- ☐ Cropping
  - ☐ Dairy
  - ☐ Deer
  - ☐ Sheep
  - ☐ Beef
  - ☐ Dairy Support
  - ☐ Other
- 

Q4 What other farming activities do you undertake on the property? (select as many as apply)

- ☐ Cropping
  - ☐ Dairy
  - ☐ Deer
  - ☐ Sheep
  - ☐ Beef
  - ☐ Dairy Support
  - ☐ Other
  - ☐ None
-

Q5 What is the land on your property like? (Select all that apply)

- ☐ Flat (0-7 degrees)
  - ☐ Rolling (8-15 degrees)
  - ☐ Hill (16-25 degrees)
  - ☐ Steep (26 degrees +)
- 

Q6 What size is your farm?

- ☐ 0-40ha
  - ☐ 41-200ha
  - ☐ 201-500ha
  - ☐ 501-1000ha
  - ☐ 1000ha +
- 

Q7 Where is your farm located? (If you have multiple farms, select as many areas as apply)

- ☐ Te Anau Basin
- ☐ Upper Mataura
- ☐ Lower Waiau
- ☐ Oreti
- ☐ Aparima
- ☐ Lower Mataura











Q8 Move the percentage slider bar to show how often you use the following management practices?

Fencing stock out of waterways	
Installing culverts or bridges at stock crossings	
Installing a stock water system	
Planting next to waterways	
Protecting and/or enhancing natural swamps/wetlands	
Installing sediment traps	
Implementing a Farm Environmental Management Plan	
Implementing a Nutrient Management Plan	
Soil testing for nutrient optimisation	
Identifying critical source areas and strategically grazing winter paddocks	

Q9 In your opinion, how many other farmers in your area use the following management practices on their properties?

Fencing stock out of waterways	
Installing culverts or bridges at stock crossings	
Installing a stock water system	
Planting next to waterways	
Protecting and/or enhancing natural swamps/wetlands	
Installing sediment traps	
Implementing a Farm Environmental Management Plan	
Implementing a Nutrient Management Plan	
Soil testing for nutrient optimisation	
Identifying critical source areas and strategically grazing winter paddocks	

Q10 How effective do you think the following activities are for improving water quality?

Soil testing for nutrient optimisation	
Installing sediment traps	
Installing a stock water system	
Implementing a Farm Environmental Management Plan	
Fencing stock out of waterways	
Planting next to waterways	
Implementing a Nutrient Management Plan	
Protecting and/or enhancing natural swamps/wetlands	
Installing culverts or bridges at stock crossings	
Identifying critical source areas and strategically grazing winter paddocks	

Q11 For the actions below, select as many as apply to your farm.

What makes it difficult for you to undertake the following practices?

	Costs too much money	Takes too much time/effort	I haven't thought about it yet	I don't see the benefit	Does not apply to my farm	I already do it
Soil testing for nutrient optimisation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Installing sediment traps	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Installing a stock water system	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Implementing a Farm Environmental Management Plan	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Fencing stock out of waterways	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Planting next to waterways	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Implementing a Nutrient Management Plan	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Protecting and/or enhancing natural swamps/wetlands	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Installing culverts or bridges at stock crossings	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Identifying critical source areas and strategically grazing winter paddocks	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Q12 What is your position on the farm?

- ☐ Owner-Operator
  - ☐ Manager/Assistant Manager
  - ☐ Equity Partner
  - ☐ Farmhand/Farm Assistant
  - ☐ Off-site Owner
  - ☐ Share or Contract Milker
  - ☐ Leaseholder
  - ☐ Stock/Herd Manager
  - ☐ Other
-

Q13 What is the highest level of qualification you hold?

- ☐ No Qualification
  - ☐ Level 1 Certificate (School Certificate)
  - ☐ Level 2 Certificate (6th Form Certificate)
  - ☐ Level 3 Certificate (Bursary)
  - ☐ Level 4, 5 or 6 Certificate/Diploma
  - ☐ Bachelor Degree & Level 7 Qualification
  - ☐ Postgraduate and Honours Degrees
  - ☐ Masters Degree
  - ☐ Doctorate Degree
  - ☐ Overseas Secondary School Qualification
  - ☐ Not Sure
- 

Q14 How many years of farming experience do you have?

- ☐ 0-5 years
  - ☐ 6-10 years
  - ☐ 11-20 years
  - ☐ 21-30 years
  - ☐ 30 years +
-

Q15 What is your age?

☐ 16-24

☐ 25-34

☐ 35-44

☐ 45-54

☐ 55-64

☐ 65-74

☐ 75+

Q16

Thanks for taking the time to complete the survey.

If you are interested in entering the draw to win a helicopter flight for two people in Fiordland, please enter your name and the best way to contact you if you win.

All names and contact details will be kept separate from the answers given. Your responses to the questions will remain anonymous.

You can only take this survey once and there is only one entry per person.

☐ Name \_\_\_\_\_

☐ Contact number or email \_\_\_\_\_

End of Survey

---



## Appendix B

### Survey Invitation Flyer



New Zealand's specialist land-based university

# You are invited to participate in the **SOUTHLAND FARMER SURVEY**

Complete the survey before August 4th 2017,  
and enter the draw to win a helicopter flight  
for two in Fiordland.

Go to:

[www.southlandfarmersurvey.com](http://www.southlandfarmersurvey.com)

or scan the QR code below



# RESEARCH INFORMATION

You are invited to participate in a project which looks at on-farm management practices and their connection to water quality in Southland.

- Your participation will involve completing an online survey, which I estimate will take 5 to 10 minutes. The survey will ask you various questions related to on-farm management practice and will be open until midnight on August 4th 2017
- The results of the project will be published in my Master's thesis and may be submitted for publication in academic journals
- Participation in this research is voluntary and there is no obligation to take part. This project has been reviewed and approved by the Lincoln University Human Ethics Committee. If you have any questions about the project, I would be happy to discuss these with you. Please contact me at the email address below
- Once you complete the survey you will be asked if you would like to enter the draw to win a helicopter flight. This involves giving your name and a valid contact method; your contact information will only be used for the prize draw. The winner will be drawn on 16/08/2017 and will have the option of either a scenic flight for two people, or the equivalent cost (\$390) to put towards a flight of their choice



Researcher: Sarah-Jane Luoni  
Sarah-Jane.Luoni@lincoln.ac.nz

Supervisor: Professor Geoff Kerr  
geoffrey.kerr@lincoln.ac.nz

**Go to: [www.southlandfarmersurvey.com](http://www.southlandfarmersurvey.com)**

## Appendix C

### Comparison to Southland Census Statistics Chi-Square Test

Education Observed				Education Expected			
	Survey	Census			Survey	Census	
No Qualification	14	19,875	19889	No Qualification	33	19856	19889
Level 1	9	11,535	11544	Level 1	19	11525	11544
Level 2	13	9,915	9928	Level 2	17	9911	9928
Level 3 or Overseas School	8	4,539	4547	Level 3 or Overseas School	8	4539	4547
Level 4, 5 or 6	25	12,723	12748	Level 4, 5 or 6	21	12727	12748
Bachelor and above	42	7,629	7671	Bachelor and above	13	7658	7671
Total	111	66,216	66327	Total	111	66216	66327
Chi-square	84.51						
Degrees of Freedom	5						
Probability	9.54E-17						

Age Observed				Age Expected			
	Survey	Census			Survey	Census	
16-24	6	11451	11457	16-24	17	11440	11457
25-34	19	10749	10768	25-34	16	10752	10768
35-44	23	12150	12173	35-44	18	12155	12173
45-54	27	13701	13728	45-54	21	13707	13728
55-64	29	11478	11507	55-64	17	11490	11507
65+	8	14619	14627	65+	22	14605	14627
Total	112	74148	74260	Total	112	74148	74260
Chi-square	27.74						
Degrees of Freedom	5						
Probability	4.10E-05						

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